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ABSTRACT

This study describes the assistance relationships between teachers engaged in school-based education reform and the full-time facilitators hired to provide their training and support. The model that supplies these facilitators to Maine's Beacon Center schools is unique in combining three important design factors: (1) the science content expertise of the facilitators; (2) the duration of their time on site; and (3) the intensity of the assistance which they were able to provide. This study investigates the perceptions of both facilitators and their constituent teachers regarding the usefulness of the assistance provided as well as the reported impact of facilitators' assistance on teachers' science practices. Findings indicate that assistance provided to teachers who are engaged in reform should be situation-specific and that facilitators should have both content and pedagogical knowledge and be able to provide support in both areas. Contains 67 references. (DDR)

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The Assistance Relationship Between Content-Specialist Science Facilitators and Their Constituent Teachers

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I. Purpose

In the pervasive climate of school reform in America in the 1990s, it is important to understand how to provide teachers the help they need to achieve their reform goals. It would be useful for persons interested in reform of school science teaching and learning to understand first what content-specialist science facilitators can do to provide such assistance to teachers, second whether that assistance may be perceived as helping, and finally what difference such assistance can make in teachers' practice. Seen purely as a question of resource-allocation of reform dollars, the presence of facilitators throughout a long-term intervention is a substantial expense. Given such a commitment of resources to reform, it is important to determine what teacher assistance occurs during the initiative's funding period, and whether changes in teaching practice actually result.

This study described the assistance relationships between teachers engaged in school-based science education reform and the full-time facilitators hired to provide their training and support. The model that supplied these facilitators to Maine's "Beacon Center" schools was unique in combining three important design factors: the facilitators' science *content expertise*, the *duration* of their time on site (five years), and the *intensity* of the assistance which they were able to provide (50% to 80% of the facilitators' time was spent in their assigned schools, depending on the year of the study). The study investigated the perceptions of both facilitators and their constituent teachers regarding the usefulness of the assistance provided by facilitators. Finally, the study investigated the reported impacts of facilitators' assistance on teachers' science teaching practices.

Studies addressing content-specific teacher assistance provided over the full term of a reform initiative are scarce. While facilitators can be commonly found assisting school reform initiatives, it is rarer to locate facilitators who possess specific content teaching expertise that matches the reform goals and who, in addition, are available to provide intensive teacher training and support for the full life of a long-term reform project. The 17 facilitators and teachers chosen as participants in this study worked within such a model, a part of Maine's Systemic

Initiative for science and mathematics education reform. The study occurred over a period spanning Years Three and Four of Maine's five-year National Science Foundation systemic initiatives grant. Seven education districts in Maine had been identified as reform sites--locally named "Beacon Centers"--and participants from three of the Centers were the focus of the study reported here.

The study's research questions follow.

1. What assistance activities in science teaching reform do science facilitators report that they provide to Beacon Center teachers?
2. How do classroom teachers describe these assistance activities?
3. According to participants, how useful are the assistance efforts of science facilitators?
4. According to facilitators and the teachers they assist, what effects on teacher practice result from facilitators' assistance efforts?

II. Conceptual Framework

This study is framed in general by research methodologies in the field of school reform, and in particular research methodologies for science education reform that address teacher capacity-building and change facilitators/agents. School reform research has provided an increasingly comprehensive understanding of the factors involved in creating and sustaining school change (Fullan, 1993; Sarason, 1991), and a recognition of the multiple variables simultaneously bearing upon a reform project's chances of success (Huberman & Miles, 1984). Hall and Hord (1984), Lieberman (1992), Huberman and Miles (1984), and other researchers have provided insights and methodological direction in the study of achieving sustainable reform through teacher-level interventions. Elmore (1995), Corcoran and Goertz (1995) and others have highlighted "capacity-building" among teachers, finding a strong link between teachers' content knowledge and student achievement. Several studies (Miles, Saxl & Lieberman, 1988; Berman & McLaughlin, 1975) have documented the skills utilized and roles occupied by change facilitators. The study reported here addresses school science education reform in a content-specific context, and in a setting that provided full-time facilitator support to teachers.

III. Methods

The methods determined to be most appropriate for the study were qualitative, consisting almost exclusively of interview data gathered from three school-site cases found in Maine's State Systemic Initiative. Facilitators and a sample of their constituent teachers participated in semistructured interviews which had been developed to elicit descriptions of facilitators' assistance, perceptions of usefulness of that assistance, and accounts of impacts on science teaching ascribed to facilitator assistance. The study began with recruitment of three of the seven available Beacon Center science facilitators, "grand tour" interviews (Spradley, 1979) with these three participants, and "Daily Activity Logs" (DALs) from a sample of their working days.

The grand tour interview data and DALs revealed projects and candidate teachers from which to recruit teacher participants at each of the three sites. Teachers were sampled in such a way as to reflect the various projects, schools and active groups of teacher constituents at each of the three Beacon Center's. Current projects cited by facilitators in interviews combined with the names of teachers identified in facilitator DALs resulted in a teacher sampling strategy ~~was developed~~ for each of the three sites. Following recruitment of a total 14 teacher participants from the facilitators' Beacon sites, semistructured interviews with each teacher took place over the summer of Beacon Year Three. Audiotapes of interviews were transcribed in preparation for data analyses. The final data collection strategy involved semistructured interviews with the three facilitators early in Beacon Year Four.

The semi-structured teacher and facilitator interviews were of parallel design, so as to maximize the analytical benefits of having recruited each population into the study. It was expected that examining data for convergence and divergence would assist in drawing valid research conclusions. Each protocol was developed with clusters of questions addressing the research goals of the study. For most questions, optional probes were added to ensure that the researcher provided opportunities for participants to fully describe their experiences and perspectives. As this interview was the primary data-gathering instrument of the study, the protocol was extensive. Individual interviews lasted at least one-and-a-half hours.

IV. Data and Analysis

For most purposes of the study, interview data were analyzed collectively, so that generalizable conclusions about the facilitator model might be drawn where possible. Data were also analyzed for within-site patterns of assistance in an effort to determine whether site- or facilitator-specific factors may have influenced the assistance relationship occurring between facilitators and their constituent teachers.

Interview transcripts were initially read and coded for the research question(s) being addressed. Most data for a given research question were found in participant responses to items designed to address that question. However, since participants were describing complex events and recalling their reactions to them, it was also expected that information relating to any research question might be found anywhere in a transcript. For example, statements that conveyed a teacher's perception of the usefulness of facilitator's assistance might be made while defining kinds of assistance received. Statements claiming changes in science teacher's practice might also occur in this same section.

Analyses of the data pertaining to teacher assistance by facilitators (Research questions 1 & 2) involved first developing "Assistance Categories." Assistance categories were strategy codes (Bogdan & Biklan, 1992) for sections of interview text in which types of facilitator-teacher assistance were described. Utilizing participants' own words where possible, assistance categories were terms or phrases that provided categorical logic to descriptions of facilitators' assistance efforts. A working definition of each category was developed by the researcher to test descriptions of assistance for a logical match. As each new interview was coded, existing category codes were selected for a logical fit. New categories were developed in cases where the assistance being described did not fit a category and its working definition. No categories or limits to codes were assumed *a priori*.

Following coding and category descriptions, each participant's comments were compiled separately by assistance category. Thus, participant accounts could be cross-referenced for

category consistency, exemplar quotes could be selected for each category, and patterns could be discerned within and across sites.

Interview transcripts were also examined and "tagged" for participant statements relating to the usefulness of assistance (Research Question 3). Such statements were expected to arise anywhere in interview protocols, and especially in the context of specific incidents of assistance. Where perceptions could be logically inferred as well as where they were stated categorically, both cases were identified for analysis, then typed verbatim into summaries for each participant.

Analyses of participant statements were conducted with the expectation that participants judged the utility value of facilitators' assistance by criteria, either stated or implicit. Pertinent sections of interviews were read with the goal of determining the nature of these criteria. Perceptions were analyzed for semantic similarities and differences, resulting in the creation of two sets of criteria, one from facilitators and one from teachers.

For purposes of this study an impact on teacher practice (Research Question 4) was defined as a change in teachers' professional behavior, including instruction and assessment strategies, curricular material selection and teacher attitudes and dispositions. Impacts cited in interview data included claims of a general nature and specific examples of science episodes in teachers' rooms. General claims were not considered for analysis unless also supported by details of classroom episodes, actual curriculum materials in use, or some other form of factual evidence, and in addition, unless they were connected in some way to facilitators' interventions. Data would be rejected if any conflicts or inconsistencies appeared within or between participants' accounts of the same incident.

Treatment of data which pertained to this final research question followed procedures described in sections above. Portions of transcripts which met the definition of impact on teaching practice were coded, summarized for each participant on separate forms, then analyzed for logical categorization.

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V. Findings

Seven categories of assistance were indicated by both facilitators and their teachers across all three sites in the study. The categories and their operational definitions are:

1. Content Knowledge. Situations when facilitators utilized their science content knowledge to provide teachers with technical or specialized content information prior to a unit or lesson.

2. Direct classroom support. Instances of model teaching and/or co-teaching involving the physical presence of the facilitator in the classroom to support science teaching.

3. Indirect classroom support. Assistance with the expressed or implied intention to implement a classroom science teaching innovation. The facilitator was not typically present in the classroom to support science learning, but rather was providing resources or ideas to support a specific unit/lesson.

4. Professional development. Instances in which facilitators, acting as leaders and/or organizers, provided individuals or groups with professional growth opportunities of various descriptions. Classroom implementation of an innovation did not always follow closely in time, if at all.

5. Connections. Instances in which facilitators linked specific teachers with a) other teachers or b) other assistance providers, to support science teaching innovations.

6. Resource-finding. Assistance that entailed facilitators matching age-appropriate and high-quality resources (e.g., print, software, equipment) with teachers' needs, typically on request. This form of assistance involved no implied or express intention to implement an innovation; hence, it was more speculative.

7. Science education leadership. Assistance wherein facilitators coordinated the efforts of teachers so that various programs or initiatives moved forward and were sustained.

Broadly speaking, these categories include those which assisted teachers in their efforts to implement innovative curriculum and/or practices into their delivery of classroom science: content knowledge, direct and indirect classroom assistance, resource-finding and connections to

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other professionals. Other forms of assistance included one that added generally to teachers' capacities (professional development), and one that promoted and guided overall efforts (leadership). These forms of assistance occurred at all three sites in the study, although there were unique patterns in the frequency with which each kind occurred at a site. There were also factors described at each site that appear to have affected the forms of assistance that facilitators provided. Such factors, which varied among sites in their influence over facilitators' ability to provide teacher assistance, included administrative support, administrator turnover, facilitator turnover (some participants worked at sites where facilitator positions had changed hands within the five-year-project's span), colleague support/non-support and site size and demographics.

Teacher perceptions of what made facilitator assistance useful (Research Question 3) were grouped into two broad categories. First, teachers overwhelmingly believed that assistance was most useful when it possessed a feature of immediate application or "implementability." Facilitators couched this same criterion of usefulness in terms of their ability to adjust assistance so as to meet teachers' needs. Second, teachers valued professional growth resulting from facilitator assistance. Some teacher participants also revealed an appreciation for their own professional growth in areas such as confidence, knowledge of content and awareness of national standards.

Three reported impacts of facilitator assistance on teachers' practice (Research Question 4) were also documented in this study. First, most participants reporting assistance from science facilitators said they spent more time on science as the result of their facilitators' assistance efforts. The extra time spent on science was further characterized by the utilization of new curriculum materials and/or instruction and assessment methods. Second, some teachers receiving assistance from science facilitators reported having experienced shifts in their science teaching philosophy or instructional preferences in creating exemplary science experiences for students. Such shifts included open-ended instruction and integration of science with other subjects among others. Finally, for some teachers at all three Beacon Centers facilitator assistance was reported to have resulted in their willing participation in systems-level changes in

science teaching--that is, changes involving the teachers but also involving elements of the school system external to those teachers' classrooms such as administrative support and curriculum coordination across grades. Typical of this category were statements by teachers who were conscious of participating in coordinated or sequenced science instruction across grades, within buildings or even as a district.

VI. Conclusions

Reform initiatives which target teacher change in content-specific settings, and system-level supports for those changes, may be informed by this research. As stated earlier, the stability of research findings across three very different school reform sites argues for the generalizability of such findings. Below is a brief set of implications for school reform derived from this research.

1. Assistance provided to teachers who are engaged in reform should be designed so that it (a) can be adapted on short notice to meet teachers' needs; (b) always includes direct and indirect classroom support at the teacher level while including a range of other supports; and (c) provides support to teachers throughout the time frame of the intervention.

2. Facilitators providing support for reform should (a) possess pedagogical content knowledge in the subject area involved in reform, (b) develop sufficient familiarity with their "site" that assistance of many forms and schedules can be targeted to constituent teachers, and (c) seek to provide assistance that is perceived as credible (timely, age-appropriate) to their constituent teachers.

3. Interventions should be designed to span relatively long periods. They should provide multiple forms of access to facilitators (electronic, formal workshops, informal contacts).

4. Site size, culture and demographics should be cause for serious consideration of adapting an intervention's design, in particular the extent of facilitator assistance that will be available.

Questions for further research

While this study fills some gaps in the research on school science education reform, there are questions that need further investigation. These include:

1. To what extent do the reported changes in teacher practice persist after the science facilitators are removed?
2. After facilitators depart what specific assistance needs arise, and what strategies do teachers employ in meeting such needs?
3. Do system-level changes (district curriculum revisions, for example) which occurred at some sites in the study persist after facilitator departure, and to what extent do such changes impact the science teaching practices of all district science teachers?
4. Do teachers who did not interact frequently with facilitators also undergo reform? All three sites had teachers who might be termed "marginal" participants in the Beacon grant, on the basis of limited interactions with Beacon events in general and their facilitators in particular. However, it is not known whether a low level of participation is always associated with limited changes in science teaching practices.

Significance

School science reform is a complex (some would say intractable) problem that has spawned many kinds of interventions over more than five decades. Unique interventions and strategies are worthy of study in that they may provide insights into how to support teachers engaged in reform. The National Science Foundation's family of systemic initiative grants encouraged such innovative designs, and Maine's Beacon facilitator model was one of them.

Science facilitators in Maine's seven Beacon Centers were experts in their field of teaching and were assigned to site-based reform projects for the entire five-year systemic initiative in Maine. Such expert assistance, provided intensely and throughout each project's duration, resulted in seven distinct forms of teacher assistance, clear criteria for what kinds of assistance teachers find useful, and three forms of impact on teacher practice.

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This study illustrates what can happen for teachers who become involved rather deeply in a reform initiative--that is, those who worked with their facilitators routinely and who, for the most part, occupied one or more active roles in their Beacon projects. Teachers were sampled in such a way as to reflect the various projects, schools and active groups of teacher constituents in each Beacon Center's reform context. Therefore, the study does not describe assistance provided to, or impacts on teaching practices of, those who might be termed marginal participants. The study cannot prove that changes in practice even for "involved" teachers will last beyond the termination of funding and the departure of facilitators. It may be speculated that the reported changes in practice will supplant former habits and preferences, given supportive settings. Teachers' vivid, enthusiastic testimonials of innovative classroom science, supported by their accounts of attitudinal "transformations" about science teaching, support such an optimistic prediction. However, this study also documented the strong influences wielded by external forces (administrative support/non-support; administrator turnover; collegial support/non-support) on teacher change. Forces such as these are likely to emerge "post-grant" in at least some of the Beacon Center schools in the study, given their commonness in school settings (Sarason, 1991). The study serves, therefore, to document the nature of the work in this unique model and the initial--sometimes powerful--impacts of such work. But it cannot predict with certainty the life expectancy of such impacts.

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